Kristen Lundebjerg – ESTA Exit Report

The Energy Test System's Area (ESTA) provides test capabilities and facilities to develop, evaluate or certify hardware in support of human spaceflight. The branch has a few different technical areas including pyrotechnics, batteries, electrical systems, power systems, propulsion and fluids. I will be mainly worked in the propulsion and fluids area. The tests/activities include testing the fluid and energy conversion systems that are required for the exploration and development of space. This group includes function and vibration tests, as well as thermal and vacuum tests. I was trained and certified as an ESTA test director in order to work on tests and sub tests with my mentor as well as the rest of the ESTA team. As a test director, I had the responsibility and authority for planning, developing, safety, execution and reporting on assigned test programs.

Over the course of the semester, I worked as a test director on a few different tests ranging from Propulsion to In-situ Resource Utilization (ISRU) projects. Each test had its own set of challenges and learning curves related to what I already know and what I need to know to successfully contribute to the projects. Projects relate to the ISS, EVA's, Orion and future space missions. Each project is based off of a request to the ESTA branch from an outside branch. The test I worked on were all NASA requests. Within each request, I scheduled between the test requestors, the branch technicians, facilities and with my own schedule to complete the work and meet deadlines.

During the start of my internship, I worked on creating a simulated Mars atmosphere in a small vacuum chamber. In the future, the design of the smaller chamber can be scaled into any of the larger vacuum chambers on site. Once created, this can be used to test items in a simulated Mars environment. During this process, I learned more about vacuum chambers and how they work, as well as what the surface of Mars is like. The project will not be completed in my time here because higher priority work came into ESTA. During work on this project, I learned how to use Graphite for fluid schematics and VacTran for vacuum system modeling.

As part of my training, I took a class on working with pressure systems designs. This included learning the codes JSC follows and how to go through the design review and inspection process. I used the skills gained in this class to run the Cleanliness Verification System through a design review and Class 1 inspection. This system is now a building 353 facility system and can be used whenever needed. A design review consisted of an ESTA Drawing, a Hazard Analysis, and an Operation Checklist. The original design for the system was to collect samples from a Shuttle Orbital Maneuvering System (OMS) engine that will be used on the ORION Service Module. Samples were to be collected after vibration and fluid testing to show engine cleanliness levels were maintained. Without using a sample pad, the system can also be used as a flow metering system.

Another project I worked on was an ESM & Orion CM Prop Leak Detection Feasibility Test. This is a preliminary test to determine if a very small leak rate could be detected in a hypergolic propulsion system by a drop in environment temperature. The original design for this test included a 40 micron orifice with a leak rate of .17 kg per hour. I learned how to use a Design Flow Simulation (DFS) software to estimate the require water flow from the facility. A small glass vacuum chamber was used for the majority of testing to simulate space environment. Through testing, data showed there was a slight drop in temperature in the free air surrounding the stream. The test setup is being re-designed to be used with a better propellant simulator, such as IPA. The design of the new test fixture will be similar to one

that would be found on orbit or in future space travels rather than just a place an a stream of water. This will give us a better idea of the feasibility of temperature monitoring in space travel.

One of the final projects I worked on was the Simplified Aid of EVA Rescue (SAFER) Test Module Flight Spare Relief Valve Thermal and Vibe. The objective of this project was to subject two relief valves to thermal cycling and vibration to failure they would induce failures seen earlier this year. Pre-test activities included getting a Pressure System Design Review and a Class 1 inspection on the test support equipment. The test fixture also had to be proof tested prior to use to ensure it would not burst during functional tests. After approval to proceed from the Test Readiness Review board, test was run at the thermal chamber in building 353 and the vibration table in building 352. There were 5 function tests throughout testing, these determined the pressure needed to pop the relief valve and the pressure at which it will reseat. The results of this will determine if the relief valve is still safe to use.

My other work at ESTA included working with technicians in order to program and build up test fixtures. This included learning how to bend pipes for buildup, how to connect to a vacuum pump to a system and the different fittings that can be used, how to use basic programming, and how to use facility systems already prepared for testing. Through my experience in ESTA and the Propulsion and Fluids group, I have decided to look into a future career of Test Engineering and Space Propulsion. I will also continue pursuing positions with the government.